AN IMPROVED PROPELLOR PULLER DEVICE

Field of the Invention

This invention relates to an improved propellor puller device for removal of a propellor from a propellor shaft of a marine engine.

Background of the Invention

In the service and repair of marine engines, it is desirable to remove the propellor from the propellor shaft without damaging the shaft and, consequently, avoiding the considerable expense associated with the replacement of a propellor shaft. Ordinarily, the propellor shaft is splined and a propellor hub or sleeve is slotted for frictional engagement with the propellor shaft. In some instances, the propellor blade and hub will have a key-way type slot and be tapered for a tight frictional fit; other arrangements utilize a pin that extends through both the propellor shaft and propellor hub. Separation of the propellor shaft and hub in the prior art require external forces applied in opposite directions to the propellor shaft and propellor blades. The propellor blades extend radially from the propellor sleeve and after a period of use in a marine environment, the sleeve becomes tightly locked to the propellor shaft; unbalanced forces tend to bind the hub and shaft and thus aggravate the lock. Expeditious removal of the propellor, therefore, without severe damage to the propellor shaft or components of the engine requires a puller device that applies uniform forces that promote removal while avoiding a binding lock.

There are various types of blade configurations and arrangements for a propellor. Most marine propellors have two or three blades. It would, therefore, be desirable to provide a propellor puller device that can accommodate these various blade numbers, configurations and arrangements. The prior art discloses tension transmitting chain links or flexible chains that engage each of the propellor blades where the chains utilize a hook member that hooks to the propellor blade such that when the chain link is placed in sufficient tension, the propellor is urged from its lock with the propellor shaft. In order to place the chain links in tension and achieve sufficient tension to separate the propellor puller, devices were used that caused rotation to occur in the centering recess of the propellor shaft while transmitting a compression force to the propellor shaft. The compression, however, distorted the centering recess in the end of the

propellor shaft and consequently interfered with a uniform force distribution. The prior art discloses devices that utilize a threaded axle that threadably engages a nut member such that rotation of the threaded axle results in a compressive force being applied to the end of the propellor shaft. The conical recess located in the center of the propellor shaft at its end centers the compressive force such that it acts axially along the propellor shaft; rotation of the threaded axle transmits the compressive force through the conical recess and results in the recess becoming distorted. Thus, it is desirable to provide a propellor puller device that permits the compressive force to be transmitted through the recess to the propellor shaft by rotation of the threaded axle member without distorting the centering recess on the propellor shaft.

It is also desirable that the tension forces acting through the chain links are provided uniformly to break the friction lock between the hub of the propellor blades and the splines on the propellor shaft.

It is an object of the present invention to provide a propellor puller device that uniformly distributes the tension forces acting on the propellor hub to separate it from the propellor shaft and to permit compressive engagement with the centering recess of the propellor shaft without distortion of the recess.

Summary of the Invention

There is, therefore, provided according to the present invention, an improved propellor puller device for pulling a propellor having blades from the propellor shaft of a marine engine where the puller device utilizes a hub base member that has an upper end and a lower end and a central axis and an axially extending bore through the hub that is symmetrical with the central axis. A bolt having a first end and a second end is adapted for carriage by the hub base member within the axially extending bore to permit a translation of rotation of the bolt into axial displacement of the hub base member relative to the bolt. A live center member is carried by the bolt at its first end for compressive engagement with a centering recess located at the center of the propellor shaft. The live center member is so adapted for carriage by the bolt that rotation of the bolt relative to the live center member is permitted although the live center member is compressively induced by friction into fixed rotational relationship relative to the propellor shaft. Intermediate the upper and lower ends of the hub base member, a multiplicity of puller arms are carried in fixed relationship to the hub base member and extend radially therefrom. A plurality of flexible tension members are utilized in conjunction with the puller arms for transmitting axially directed external forces to the propellor blades upon sufficient rotation of the bolt when the live center member compressively engages the propellor shaft and upon continued rotation of the bolt, the hub base member is displaced axially relative to the bolt to place the flexible tension members in tension. The live center member, when sufficiently compressively engaged frictionally with the propellor shaft, ceases to rotate and becomes rotationally locked with the propellor shaft thus permitting the bolt to continue to rotate. Continued rotation of the bolt causes the hub base member to be displaced axially with respect to the bolt and thus increases the tension forces in the flexible tension members.

In the preferred embodiment of this invention, the hub base member has a cylindrically shaped portion and a threaded bore extending axially through the cylindrically shaped portion. The hub base member has four puller arms extending as cantilevers radially of the hub base member and are welded to the cylindrical portion. A threaded bolt engages the internal threads of the hub base member such that rotation of the bolt results in axial displacement of the hub base member relative to the bolt. The radially extending puller arms are so dimensioned and proportioned to permit a chain link to circumferentially engage a puller arm and slide relative to

the puller arm as the chain link tension member is placed in tension by rotation of the threaded bolt. The puller arms are sloped such that as the tension in the tension member is increased the chain link is permitted to slide inwardly toward the central axis of the hub base member. In the preferred embodiment, the threaded bolt has a head at its second end for applying an external torque to rotate the bolt; and the hub base member has four radially extending puller arms that are angularly spaced to permit the pulling of a propellor hub having either two or three propellor blades. To offset the torque transferred to the hub base member by rotation of the bolt, a torque lever extends radially from the hub base member for applying an opposing torque when sufficient force is applied so as to prevent rotation of the hub base member as the bolt rotates. Thus, the live center member remains in fixed relationship with the propellor shaft at its centering recess while the bolt continues to rotate thereby allowing axial displacement of the hub base member to increase the tension in the chain link members; the inclination of the puller arms to the central axis allows a chain link to slide inwardly as the tension increases while the compressive force exerted by the bolt remains centered on the propellor shaft thereby uniformly distributing the forces acting on the hub base member to pull it from the propellor shaft.

Brief Description of the Drawings

These, and other features and advantages, will become appreciated as the same become better understood with reference to the following specification, claims and drawings wherein:

Fig. 1 is a perspective view showing the propellor puller of this invention.

Fig. 2 is a top view of the hub base member of this invention illustrating the angular separation of the puller arms and the torque lever arm all extending radially from the hub base member.

Fig. 3 is a partial cross-sectional view illustrating the hub base member and bolt of this invention threadably engaged and the live center member carried by the bolt in compressive engagement with the propellor shaft.

Fig. 4 is a part cross-sectional view illustrating the live center member of this invention in compressive engagement with the propellor shaft.

Detailed Description

Fig. 1 illustrates the improved propellor pulling device **1** of this invention positioned for applying external forces to a propellor hub **2** of a marine engine (not shown) to remove the hub from the shaft. Propellor hub **2** is shown partially cross sectioned through which the distal end **3** of propellor shaft **23** of the marine engine can be seen. Typically, the distal end **3** of the propellor shaft **23** is splined for engagement with the propellor hub **2** to form a tight frictional lock. With use of an engine over a period of time in a marine environment, the spline connection becomes severely locked by the effects of the water environment such as electrolytic corrosion thus requiring substantial pulling forces to overcome friction and corrosive bonding to unlock the propellor hub from the propellor shaft.

As can be seen in Fig. 1, propellor hub **2** carries propellor blades **4** that extend radially from the propellor hub. The propellor blades have a leading edge **6** and a trailing edge **7**. The leading edge provides the geometrical configuration through which forces may be transmitted to the propellor hub **2** when separating the hub from the propellor shaft.

Referring again to Fig. 1, the propellor pulling device **1** has a hub base member **8** that has an upper end **9** and a lower end **11** and a central axis **12**. By referring to Fig. 4, it can be seen that hub base member **8** has an axially extending bore **13** that is threaded for threaded engagement with bolt **14** that is also threaded for translational movement relative to the hub base member **8**. Although the hub base member and bolt are shown to be threaded in Fig. 4, the translation of rotational motion of the bolt resulting in axial displacement relative to the bolt by the hub base member may be achieved by other forms of translational engagement between the bolt and hub base member.

In Fig. 1, bolt **14** is shown to have a hexagonal head **16** for transmitting a torque to the bolt **14** at the upper end **17** of the bolt.

Referring to Fig. 4, the lower end **18** of bolt **14** carries a live center member **19** which preferably is heat treated steel having a Rockwell hardness of 65-70. The engagement end **21** of live center member **19** is conically shaped for insertion into centering recess **22** located on the distal end **3** of propellor shaft **23** where centering recess **22** is symmetrical to central axis **12**. As can be further seen in Fig. 4, the live member center member is also symmetrical about central axis **12** and has a cylindrical pin portion **24** having a smaller diameter than, but integrally a part

of, the cylinder portion **26** of the live center member **19**. Cylindrical pin portion **24** is rotationally carried by bolt **14** adjacent its lower end **18**. The rotational carriage is achieved by split-ring **27** captively seated in channel **28** that extends circumferentially in the outer surface of cylindrical pin portion **24** of the live center member; bolt **14** at its lower end **18** has an internal recess **29** for receiving cylindrical pin portion **24.** The boundary wall defined by the internal recess **29** in bolt **14** has a circumferentially extending slot **31,** into which split-ring **27** radially expands to captively hold live center member **19** in fixed axial relationship with bolt **14**. The rotation of the bolt **14** when live member **19** becomes frictionally locked in centering recess **22** under compressive engagement with propellor shaft **23**, is thus permitted to continue even though live center member **19** is in locked rotational relationship with the propellor shaft.

Fig. 2 illustrates the preferred embodiment of hub base member **8**. As can be seen in Fig. 2, hub base member **8** has four radially spaced puller arms **32, 33, 34,** and **35** extending radially from hub base member **8**. In the preferred embodiment, the puller arms are welded **36** to the cylinder portion **37** of hub base member **8**. Another embodiment for hub base member **8** is shown in Fig. 1. In this embodiment, hub base member **8** has three puller arms **32', 33'** and **34'.** Referring again to Fig. 2, central axis **12** is perpendicular to the page of Fig. 2 and, as can be seen, each of the puller arms **32, 33, 34** and **35**, has a radial axis that intersects central axis **12** of the hub base member **8**. In Fig. 3, puller arms **32, 33, 34** and **35** are shown in perspective, and as can be seen in Fig. 3, the puller arms have a rectangular cross-section and are inclined to central axis **12** where the upper face **38** of each puller arm is a smooth surface and is sloped downwardly in a direction toward central axis **12**. Although the puller arms have been shown to have a rectangular cross-section, another cross-section would be suitable so long as there where a smooth surface to permit a sliding relationship with chain link **40** as illustrated in Fig. 1.

Rotation of bolt **14** in a clockwise direction, will cause hub base member **8** to rotate with bolt **14** unless rotation of the hub base member is restrained by applying an opposite torque to hub base member **8**. Restraint of rotation of hub base member **8** is achieved through torque lever **39** which restrains hub base member **8** such that the hub base member remains in fixed angular relationship with propellor hub **2** as bolt **14** is rotated. However, as bolt **14** is rotated, hub base member **8** will be displaced axially with respect to propellor shaft **23** in a vertical direction along central axis **12** as bolt **14** is rotated clockwise.

In the preferred embodiment of hub base member **8** as shown in Fig. 2, puller arms **32, 34,** and **35** are angularly displaced from each other by one hundred and twenty degrees to accommodate a propellor hub having three propellor blades. The preferred embodiment also accommodates a propellor hub that has two propellor blades that are angularly spaced one hundred and eighty degrees. As can be seen in Fig. 2, the puller arms **33** and **35** are angularly spaced by one hundred and eighty degrees. Thus, the preferred embodiment would be adaptable to accommodate propellor configurations of propellor hubs having two or three blades.

Referring again to Fig. 1, a plurality of flexible tension members **41** and **42** are illustrated, the flexible tension members have a series of chain links **40** where the engagement of the tension member with a puller arm is achieved by mounting the uppermost chain link to the puller arm so that it is in slidable relationship with the puller arm. At the opposing or bottom end of the series of chain links that form the tension member, a hook **43** is coupled to the bottom chain link for grasping the leaning edge **6** of a propellor blade. In the preferred embodiment of this invention, the number of tension members utilized for separating the propellor hub from the shaft will be the same as the number of blades. Thus, as illustrated in Fig. 2, in the preferred embodiment of the hub base member **8**, puller arms **32, 34** and **35** are angularly spaced at angles of one hundred and twenty degrees and respectively carry a flexible tension member having a hook **43** at its bottom end and a chain link **40** at its upper end that is slidably carried by a respective puller arm. Thus, in operation, when an external torque is applied to bolt **14** to induce clockwise rotation, and an opposing torque applied by lever arm **39** so as to preclude rotation of hub base member **8,** continued rotation of bolt **14** will displace hub base member **8** in a vertical axial direction placing the flexible tension members in tension. As compressive engagement begins to occur between live center member **19** and the distal end **3** of propellor shaft **23** the live center member will cease rotating with respect to the propellor shaft. As bolt **14** continues to rotate relative to live center member **19**, vertical displacement of hub base member **8** will occur. This will place the flexible tension members in an increasing state of tension that increases the force acting through hook **43** on the propellor blade. As tension increases in the flexible tension members, chain link **40** will slide radially inwardly toward central axis **12** thereby permitting uniform distribution of the pulling forces acting on the propellor hub to separate the hub from the propellor shaft. Since no relative motion occurs between the live center member and the

centering recess on the propellor shaft, no distortion occurs to the centering recess and thus a more uniform distribution of forces and moments are transmitted to the propellor hub to separate it from the propellor shaft.

While I have shown and described embodiments of an improved propellor pulling device for pulling a propellor having blades from the propellor shaft of a marine engine, it is to be understood that the invention is subject to many modifications without departing from the scope and spirit of the claims as recited herein.